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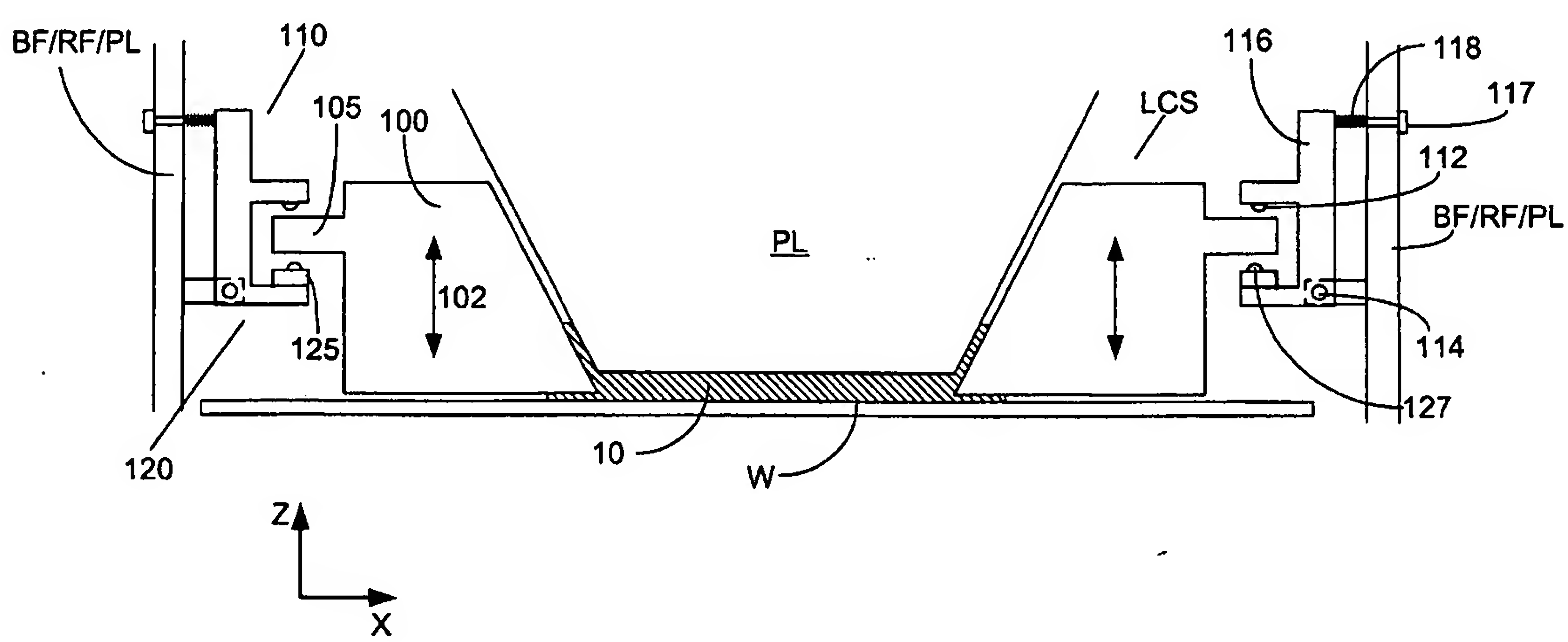
(54) Lithographic apparatus and device manufacturing method

(57) A lithographic projection apparatus is disclosed in which a liquid confinement system which confines liquid to a localized area between a final element of the projection system and the substrate is restricted in its movement in the direction of the optical axis of the apparatus by stoppers attached to the base frame or the projection system.

Fig. 5



EP 1 519 230 A1

Description

[0001] The present invention relates to a lithographic projection apparatus comprising:

- a radiation system for supplying a projection beam of radiation;
- a support structure for supporting patterning means, the patterning means serving to pattern the projection beam according to a desired pattern;
- a substrate table for holding a substrate;
- a base frame for supporting said substrate table;
- a projection system for projecting the patterned beam onto a target portion of the substrate, said projection system being mechanically decoupled from said base frame,
- a liquid supply system for at least partly filling a space between a final element of said projection system and said substrate with liquid;
- said liquid supply system comprising a liquid confinement system for confining said liquid to a localized area of said substrate.

[0002] The term "patterning means" as here employed should be broadly interpreted as referring to means that can be used to endow an incoming radiation beam with a patterned cross-section, corresponding to a pattern that is to be created in a target portion of the substrate; the term "light valve" can also be used in this context. Generally, the said pattern will correspond to a particular functional layer in a device being created in the target portion, such as an integrated circuit or other device (see below). Examples of such patterning means include:

- A mask. The concept of a mask is well known in lithography, and it includes mask types such as binary, alternating phase-shift, and attenuated phase-shift, as well as various hybrid mask types. Placement of such a mask in the radiation beam causes selective transmission (in the case of a transmissive mask) or reflection (in the case of a reflective mask) of the radiation impinging on the mask, according to the pattern on the mask. In the case of a mask, the support structure will generally be a mask table, which ensures that the mask can be held at a desired position in the incoming radiation beam, and that it can be moved relative to the beam if so desired.
- A programmable mirror array. One example of such a device is a matrix-addressable surface having a viscoelastic control layer and a reflective surface. The basic principle behind such an apparatus is that (for example) addressed areas of the reflective surface reflect incident light as diffracted light, whereas unaddressed areas reflect incident light as undiffracted light. Using an appropriate filter, the said undiffracted light can be filtered out of the reflected beam, leaving only the diffracted light behind; in this manner, the beam becomes patterned according to the addressing pattern of the matrix-addressable surface. An alternative embodiment of a programmable mirror array employs a matrix arrangement of tiny mirrors, each of which can be individually tilted about an axis by applying a suitable localized electric field, or by employing piezoelectric actuation means. Once again, the mirrors are matrix-addressable, such that addressed mirrors will reflect an incoming radiation beam in a different direction to unaddressed mirrors; in this manner, the reflected beam is patterned according to the addressing pattern of the matrix-addressable mirrors. The required matrix addressing can be performed using suitable electronic means. In both of the situations described hereabove, the patterning means can comprise one or more programmable mirror arrays. More information on mirror arrays as here referred to can be gleaned, for example, from United States Patents US 5,296,891 and US 5,523,193, and PCT patent applications WO 98/38597 and WO 98/33096, which are incorporated herein by reference. In the case of a programmable mirror array, the said support structure may be embodied as a frame or table, for example, which may be fixed or movable as required.
- A programmable LCD array. An example of such a construction is given in United States Patent US 5,229,872, which is incorporated herein by reference. As above, the support structure in this case may be embodied as a frame or table, for example, which may be fixed or movable as required.

For purposes of simplicity, the rest of this text may, at certain locations, specifically direct itself to examples involving a mask and mask table; however, the general principles discussed in such instances should be seen in the broader context of the patterning means as hereabove set forth.

[0003] Lithographic projection apparatus can be used, for example, in the manufacture of integrated circuits (ICs). In such a case, the patterning means may generate a circuit pattern corresponding to an individual layer of the IC, and this pattern can be imaged onto a target portion (*e.g.* comprising one or more dies) on a substrate (silicon wafer) that has been coated with a layer of radiation-sensitive material (resist). In general, a single wafer will contain a whole network of adjacent target portions that are successively irradiated via the projection system, one at a time. In current apparatus, employing patterning by a mask on a mask table, a distinction can be made between two different types of machine. In one type of lithographic projection apparatus, each target portion is irradiated by exposing the entire mask pattern onto the target portion in one go; such an apparatus is commonly referred to as a wafer stepper. In an alternative apparatus -commonly referred to as a

step-and-scan apparatus - each target portion is irradiated by progressively scanning the mask pattern under the projection beam in a given reference direction (the "scanning" direction) while synchronously scanning the substrate table parallel or anti-parallel to this direction; since, in general, the projection system will have a magnification factor M (generally < 1), the speed V at which the substrate table is scanned will be a factor M times that at which the mask table is scanned. More information with regard to lithographic devices as here described can be gleaned, for example, from US 6,046,792, incorporated herein by reference.

[0004] In a manufacturing process using a lithographic projection apparatus, a pattern (e.g. in a mask) is imaged onto a substrate that is at least partially covered by a layer of radiation-sensitive material (resist). Prior to this imaging step, the substrate may undergo various procedures, such as priming, resist coating and a soft bake. After exposure, the substrate may be subjected to other procedures, such as a post-exposure bake (PEB), development, a hard bake and measurement/inspection of the imaged features. This array of procedures is used as a basis to pattern an individual layer of a device, e.g. an IC. Such a patterned layer may then undergo various processes such as etching, ion-implantation (doping), metallization, oxidation, chemo-mechanical polishing, etc., all intended to finish off an individual layer. If several layers are required, then the whole procedure, or a variant thereof, will have to be repeated for each new layer. Eventually, an array of devices will be present on the substrate (wafer). These devices are then separated from one another by a technique such as dicing or sawing, whence the individual devices can be mounted on a carrier, connected to pins, etc. Further information regarding such processes can be obtained, for example, from the book "Microchip Fabrication: A Practical Guide to Semiconductor Processing", Third Edition, by Peter van Zant, McGraw Hill Publishing Co., 1997, ISBN 0-07-067250-4, incorporated herein by reference.

[0005] For the sake of simplicity, the projection system may hereinafter be referred to as the "lens"; however, this term should be broadly interpreted as encompassing various types of projection system, including refractive optics, reflective optics, and catadioptric systems, for example. The radiation system may also include components operating according to any of these design types for directing, shaping or controlling the projection beam of radiation, and such components may also be referred to below, collectively or singularly, as a "lens". Further, the lithographic apparatus may be of a type having two or more substrate tables (and/or two or more mask tables). In such "multiple stage" devices the additional tables may be used in parallel, or preparatory steps may be carried out on one or more tables while one or more other tables are being used for exposures. Dual stage lithographic apparatus are described, for example, in US 5,969,441 and WO 98/40791, incorporated herein by reference.

[0006] It has been proposed to immerse the substrate in the lithographic projection apparatus in a liquid having a relatively high refractive index, e.g. water, so as to fill a space between the final element of the projection system and the substrate. The point of this is to enable imaging of smaller features because the exposure radiation will have a shorter wavelength in the liquid. (The effect of the liquid may also be regarded as increasing the effective NA of the system and also increasing the depth of focus.)

[0007] However, submersing the substrate or substrate and substrate table in a bath of liquid (see for example US 4,509,852, hereby incorporated in its entirety by reference) means that there is a large body of liquid that must be accelerated during a scanning exposure. This requires additional or more powerful motors and turbulence in the liquid may lead to undesirable and unpredictable effects.

[0008] One of the solutions proposed is for a liquid supply system to confine liquid on only a localized area of the substrate and in between the final element of the projection system and the substrate using a liquid confinement or containment system (the substrate generally has a larger surface area than the final element of the projection system). One way which has been proposed to arrange for this is disclosed in WO 99/49504, hereby incorporated in its entirety by reference. As illustrated in Figures 2 and 3, liquid is supplied by at least one inlet IN onto the substrate, preferably along the direction of movement of the substrate relative to the final element, and is removed by at least one outlet OUT after having passed under the projection system. That is, as the substrate is scanned beneath the element in a -X direction, liquid is supplied at the +X side of the element and taken up at the -X side. Figure 2 shows the arrangement schematically in which liquid is supplied via inlet IN and is taken up on the other side of the element by outlet OUT which is connected to a low pressure source. In the illustration of Figure 2 the liquid is supplied along the direction of movement of the substrate relative to the final element, though this does not need to be the case. Various orientations and numbers of in- and out-lets positioned around the final element are possible, one example is illustrated in Figure 3 in which four sets of an inlet with an outlet on either side are provided in a regular pattern around the final element.

[0009] During immersion lithography the free working distance between the final element of the projection system and the substrate is of the order of 2mm. This can lead to difficulty in removing substrates from under the projection system after exposure and also in the refreshment of the immersion liquid during substrate swap. Whilst all of these considerations must be borne in mind in the design of the liquid containment system, a more important consideration is the protection of the lenses of the projection system during crash of the apparatus.

[0010] It is an object of the present invention to pro-

vide a liquid supply system with which a low free working distance can be achieved whilst the projection system is protected in the event of an apparatus crash.

[0011] This and other objects are achieved according to the invention in a lithographic apparatus as specified in the opening paragraph, characterized in that said liquid confinement system is restricted in range of movement in a direction parallel to the optical axis of said apparatus by stoppers on said base frame or attached to said projection system.

[0012] In this way a degree of movement of the liquid confinement system is possible to accommodate variation in substrate thickness and increase the distance from the substrate before swap whilst the apparatus is protected from damage by the liquid confinement system in the case of a crash. Thus, during a crash, the liquid confinement system is restricted in its movement but during operation has free movement in the Z direction (as well as Rx and Ry) required for good performance. This can be achieved without coupling the liquid confinement system to the projection system which might lead to deleterious vibrations in the projection system.

[0013] Preferably the stoppers comprise a first stopper preventing the liquid confinement system from moving closer to the final element than a first predetermined distance. This ensures that in the worst case scenario of a crash which causes a large force to be applied on the liquid confinement system in a direction towards the projection system that the projection system is protected from damage by the liquid confinement system. Preferably the first stopper is biased to a position in which the liquid confinement system is prevented by said stopper from moving closer to said final element than a second predetermined distance, wherein the second predetermined distance is greater than the first predetermined distance. This allows the liquid confinement system, during normal operation, to be moved away from the substrate and substrate table without risk of impinging on the projection system. This is useful, for example, during substrate swap on the substrate table. This can be arranged in an advantageous way if the first stopper is mounted on or is part of a rotatable member.

[0014] Preferably the stoppers comprise a second stopper for preventing the liquid confinement system from moving further away from the final element than a predetermined position. Thus, should the substrate table WT crash downwards for any reason, the liquid confinement system can be prevented from falling away from the projection system. Also this allows the liquid confinement system to be lowered away from the projection system (whilst still preventing it from falling away in the event of a crash) so that the size of the reservoir of immersion liquid under the projection system can be increased which is advantageous for circulation of immersion liquid under the projection system.

[0015] If the apparatus further comprises a stopper actuator for moving the second stopper thereby to vary the predetermined position, that actuator may be used to lift the liquid confinement system towards the projection system. This is a convenient and neat solution for actuation of the liquid confinement system in the direction of the optical axis of the apparatus without the need for applying a force to the liquid confinement system through the substrate table.

[0016] Preferably the stoppers are mechanical interference surfaces which restrict the range of movement by interacting with surfaces on the liquid confinement system. This is a reliable and simple mechanical way of restricting the range of movement of the liquid confinement system. One arrangement for the stoppers is to be positioned at three equally spaced locations around the circumference of the liquid confinement system.

[0017] According to a further aspect of the invention there is provided a device manufacturing method comprising:

- providing a substrate that is at least partially covered by a layer of radiation-sensitive material and is supported on a base frame;
- providing a projection beam of radiation using a radiation system;
- using patterning means to endow the projection beam with a pattern in its cross-section;
- projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material using a projection system which is mechanically decoupled from said base frame,
- confining a liquid in a space between the substrate and a final element of said projection system using a liquid confinement system,
- characterized by allowing said liquid confinement system to move relative to said final element in a direction substantially parallel to the optical axis of said apparatus in a range restricted by stoppers on said base frame.

[0018] Although specific reference may be made in this text to the use of the apparatus according to the invention in the manufacture of ICs, it should be explicitly understood that such an apparatus has many other possible applications. For example, it may be employed in the manufacture of integrated optical systems, guidance and detection patterns for magnetic domain memories, liquid-crystal display panels, thin-film magnetic heads, etc. The skilled artisan will appreciate that, in the context of such alternative applications, any use of the terms "reticle", "wafer" or "die" in this text should be considered as being replaced by the more general terms "mask", "substrate" and "target portion", respectively.

[0019] In the present document, the terms "radiation" and "beam" are used to encompass all types of electromagnetic radiation, including ultraviolet radiation (*e.g.* with a wavelength of 365, 248, 193, 157 or 126 nm).

[0020] Embodiments of the invention will now be described, by way of example only, with reference to the

accompanying schematic drawings in which:

Figure 1 depicts a lithographic projection apparatus according to an embodiment of the invention;
Figures 2 and 3 illustrate a liquid supply system with a liquid confinement system to which the present invention can be applied;
Figure 4 illustrates the general principles of the present invention in a cross-sectional schematic view through the apparatus; and
Figure 5 illustrates schematically an alternative liquid confinement system to which the present invention has been applied.

[0021] In the Figures, corresponding reference symbols indicate corresponding parts.

Embodiment 1

[0022] Figure 1 schematically depicts a lithographic projection apparatus according to a particular embodiment of the invention. The apparatus comprises:

- a radiation system Ex, IL, for supplying a projection beam PB of radiation (*e.g.* DUV radiation), which in this particular case also comprises a radiation source LA;
- a first object table (mask table) MT provided with a mask holder for holding a mask MA (*e.g.* a reticle), and connected to first positioning means for accurately positioning the mask with respect to item PL;
- a second object table (substrate table) WT provided with a substrate holder for holding a substrate W (*e.g.* a resist-coated silicon wafer), and connected to second positioning means for accurately positioning the substrate with respect to item PL;
- a projection system ("lens") PL (*e.g.* a refractive system) for imaging an irradiated portion of the mask MA onto a target portion C (*e.g.* comprising one or more dies) of the substrate W.

As here depicted, the apparatus is of a transmissive type (*e.g.* has a transmissive mask). However, in general, it may also be of a reflective type, for example (*e.g.* with a reflective mask). Alternatively, the apparatus may employ another kind of patterning means, such as a programmable mirror array of a type as referred to above.

[0023] The source LA (*e.g.* an excimer laser) produces a beam of radiation. This beam is fed into an illumination system (illuminator) IL, either directly or after having traversed conditioning means, such as a beam expander Ex, for example. The illuminator IL may comprise adjusting means AM for setting the outer and/or inner radial extent (commonly referred to as σ-outer and σ-inner, respectively) of the intensity distribution in the beam. In addition, it will generally comprise various other components, such as an integrator IN and a condenser CO. In this way, the beam PB impinging on the mask MA has a desired uniformity and intensity distribution in its cross-section.

[0024] It should be noted with regard to Figure 1 that the source LA may be within the housing of the lithographic projection apparatus (as is often the case when the source LA is a mercury lamp, for example), but that it may also be remote from the lithographic projection apparatus, the radiation beam which it produces being led into the apparatus (e.g. with the aid of suitable directing mirrors); this latter scenario is often the case when the source LA is an excimer laser. The current invention and Claims encompass both of these scenarios.

[0025] The beam PB subsequently intercepts the mask MA, which is held on a mask table MT. Having traversed the mask MA, the beam PB passes through the lens PL, which focuses the beam PB onto a target portion C of the substrate W. With the aid of the second positioning means (and interferometric measuring means IF), the substrate table WT can be moved accurately, *e.g.* so as to position different target portions C in the path of the beam PB. Similarly, the first positioning means can be used to accurately position the mask MA with respect to the path of the beam PB, *e.g.* after mechanical retrieval of the mask MA from a mask library, or during a scan. In general, movement of the object tables MT, WT will be realized with the aid of a long-stroke module (course positioning) and a short-stroke module (fine positioning), which are not explicitly depicted in Figure 1. However, in the case of a wafer stepper (as opposed to a step-and-scan apparatus) the mask table MT may just be connected to a short stroke actuator, or may be fixed.

[0026] The depicted apparatus can be used in two different modes:

1. In step mode, the mask table MT is kept essentially stationary, and an entire mask image is projected in one go (*i.e.* a single "flash") onto a target portion C. The substrate table WT is then shifted in the x and/or y directions so that a different target portion C can be irradiated by the beam PB;
2. In scan mode, essentially the same scenario applies, except that a given target portion C is not exposed in a single "flash". Instead, the mask table MT is movable in a given direction (the so-called "scan direction", *e.g.* the y direction) with a speed *v*, so that the projection beam PB is caused to scan over a mask image; concurrently, the substrate table WT is simultaneously moved in the same or opposite direction at a speed $V = Mv$, in which M is the magnification of the lens PL (typically, M = 1/4 or 1/5). In this manner, a relatively large target portion C can be exposed, without having to compromise on resolution.

[0027] The present invention may be applied to the liquid confinement system of Figures 2 and 3 or to any other liquid confinement system, in particular a localized

area liquid confinement system which confines the liquid to a localized area of the substrate. The present invention is suitable for use with a liquid confinement system which comprises a seal member 100 which extends around at least a part of a boundary of a space between the final element of the projection system PL and the substrate table WT. A seal is formed between the seal member 100 and the surface of the substrate W. Preferably the seal is a contactless seal such as a gas seal. This type of liquid confinement system is described in detail in European Patent Application Nos. 02257822.3, 03252955.4, 03254078.3 hereby incorporated in their entirety by reference. It is with reference to this type of liquid confinement system that the present invention is described.

[0028] Figure 4 illustrates a lithographic projection apparatus in accordance with the present invention in which a base frame BF is isolated from the ground 5 by mechanical isolators 20. The base frame supports the substrate table WT which carries the substrate W. A reference frame RF is supported by but mechanically decoupled from the base frame BF by mechanical isolators 30. The projection system PL is supported by the reference frame. A liquid confinement system LCS comprising a seal member 100 is supported on the substrate table WT through action of a bearing (not illustrated) and may or may not be partially or fully supported directly by the base frame BF. The bearing may be a gas bearing which also acts to seal the immersion liquid in the reservoir and which helps to prevent damage to the substrate W in the case of a stage crash.

[0029] The seal member 100 is moveable in the Z direction (the direction of the optical axis) as well as the Rx and Ry directions. The seal member 100 has flanges 105 which extend towards the base frame BF. Upper and lower stoppers 110, 120 limit the range of movement of the liquid confinement system LCS in a direction parallel to the optical axis of the projection system PL by mechanical interference with surfaces of the flange 105. Movement in the X and Y directions (perpendicular to the optical axis of the projection system) of the liquid confinement system LCS is substantially prevented.

[0030] Figure 5 illustrates in more detail the interaction between the flange 105 and the stoppers 110, 120.

[0031] The stoppers 110 and 120 are positioned at regular intervals around the circumference of the liquid confinement system LCS. Preferably the upper and lower stoppers 110 and 120 are positioned in opposition to one another and there are at least three pairs of upper and lower stoppers around the circumference of the liquid confinement system LCS.

[0032] The upper stopper 110 is attached to the base frame BF or to the projection system PL through the reference frame RF or alternatively directly to a strong part of the projection system PL. The upper stopper 110 is attached or part of a pivotable member 116 which pivots around pivot point 114 which is attached to the base frame BF or to the projection system PL through the reference frame RF or directly to a strong part of the projection system. The member 116 has a stopper surface 112 which contacts with an upper surface of the flange 105 of the liquid confinement system LCS to restrict the amount of movement towards the projection system PL the liquid confinement system LCS can make. The pivotable member 116 is biased with a spring 118 so that the surface 112 can move between a first position and a second position on application of an increasing force. The first position is the position in normal use which prevents the liquid containment system from contacting the projection system PL and holds it a safe distance (second predetermined distance) away from the projection system PL. When a large force is applied to the liquid confinement system LCS, such as might be experienced during crash of the apparatus, for example by the substrate table WT moving in the Z direction accidentally, the spring 118 will contract and the stopper surface 112 will move to its second position. In this second position the liquid containment system is still held a first predetermined distance away from the projection system PL so that the projection system PL cannot be damaged by the liquid confinement system LCS coming into contact with it. The exact location of the second position can be varied by a screw member 117. The advantage of having two positions for the upper stopper 110 is that there is some damping in the restriction of movement of the liquid confinement system LCS as it moves towards the projection system PL.

[0033] The lower stopper 120 is comprised of a stopper surface 127 which contacts with the lower surface of the flange 105 to prevent further downward movement of the liquid confinement system LCS when the stopper surface 127 interacts and mechanically interferes with the lower surface of the flange 105. The lower stopper 120 is attached to the base frame BF or to the projection system PL through the reference frame RF or directly to the projection system PL. The stopper surface 127 is part of or attached to the pivotable member 116. A stopper actuator 125 can be incorporated into the lower stopper 120 so that the lowest position which the liquid confinement system LCS can achieve can be increased to move the liquid confinement system LCS up towards the projection system PL. Thus, during normal imaging operation of the apparatus the free working distance between the last element of the projection system PL and the substrate W can be low (of the order of 2mm) whilst during exchange of the substrate W the liquid confinement system LCS can be moved away from the substrate towards the projection system PL by the actuators 125. The actuators 125 may be a simple bellows type actuator, a piezoelectric actuator etc. Preferably when not actuated, the actuator 125 is raised so that in the event of power failure the liquid confinement system LCS is moved to the upper stopper 120.

[0034] The design of the lower stopper 120 is particularly suited to the use of a shutter member used during substrate swap as disclosed in EP 03254059.3, hereby

incorporated in its entirety by reference. After exposure, the substrate table WT is moved so that the projection system PL and liquid confinement system LCS is over a shutter member which is a plate of size larger than the aperture of the liquid confinement system LCS. The member is attached to the bottom of the liquid confinement system to block the aperture and is then lifted away from the substrate table WT by actuation of the stopper actuator 125. Once the substrate table WT has been moved away, the liquid confinement system can be lowered to increase the volume of liquid under the lens which helps with refreshment of the liquid during substrate swap.

[0035] As can be seen the present invention maximizes the movement of the liquid confinement system whilst allowing the minimization of immersion liquid thickness during exposure. The seal means between the seal member 100 and the wafer W are not illustrated in Figure 5 but the seal means can also be used to move the seal member 100 in the Z direction during imaging of the substrate W. Further actuation means can also be present to move the liquid confinement system in the Z direction.

[0036] Whilst specific embodiments of the invention have been described above, it will be appreciated that the invention may be practiced otherwise than as described. The description is not intended to limit the invention.

Claims

1. A lithographic projection apparatus comprising:

    - a radiation system for providing a projection beam of radiation;
    - a support structure for supporting patterning means, the patterning means serving to pattern the projection beam according to a desired pattern;
    - a substrate table for holding a substrate;
    - a base frame for supporting said substrate table;
    - a projection system for projecting the patterned beam onto a target portion of the substrate, said projection system being mechanically decoupled from said base frame,
    - a liquid supply system for at least partly filling a space between a final element of said projection system and said substrate with liquid;
    - said liquid supply system comprising a liquid confinement system for confining said liquid to said substrate;

    characterized in that said liquid confinement system is restricted in range of movement in a direction parallel to the optical axis of said apparatus by stoppers on said base frame or attached to said projection system.

2. A lithographic projection apparatus according to claim 1, said stoppers comprising a first stopper preventing said liquid confinement system from moving closer to said final element than a first predetermined distance.

3. A lithographic projection apparatus according to claim 2, wherein said first stopper is biased to a position in which said liquid confinement system is prevented by said stopper from moving closer to said final element than a second predetermined distance, wherein said second predetermined distance is greater than said first predetermined distance.

4. A lithographic projection apparatus according to claim 3, wherein said first stopper is mounted on or its part of a pivotable member.

5. A lithographic projection apparatus according to any one of the preceding claims, wherein said stoppers comprise a second stopper for preventing said liquid confinement system from moving further away from said final element than a predetermined position.

6. A lithographic projection apparatus according to claim 5, further comprising a stopper actuator for moving said second stopper thereby to vary said predetermined position.

7. A lithographic projection apparatus according to any one of the preceding claims, wherein said stoppers are mechanical interference surfaces which restrict the range of movement by interacting with surfaces on said liquid confinement system.

8. A lithographic projection apparatus according to any one of the preceding claims, further comprising an actuator for moving said liquid confinement system in said direction.

9. A device manufacturing method comprising:

    - providing a substrate that is at least partially covered by a layer of radiation-sensitive material and is supported on a base frame;
    - providing a projection beam of radiation using a radiation system;
    - using patterning means to endow the projection beam with a pattern in its cross-section;
    - projecting the patterned beam of radiation onto a target portion of the layer of radiation-sensitive material using a projection system which is mechanically decoupled from said base frame,
    - confining a liquid in a space between the sub-

strate and a final element of said projection system using a liquid confinement system,

characterized by allowing said liquid confinement system to move relative to said final element in a direction substantially parallel to the optical axis of said apparatus in a range restricted by stoppers on said base frame or attached to said projection system.

Fig. 1

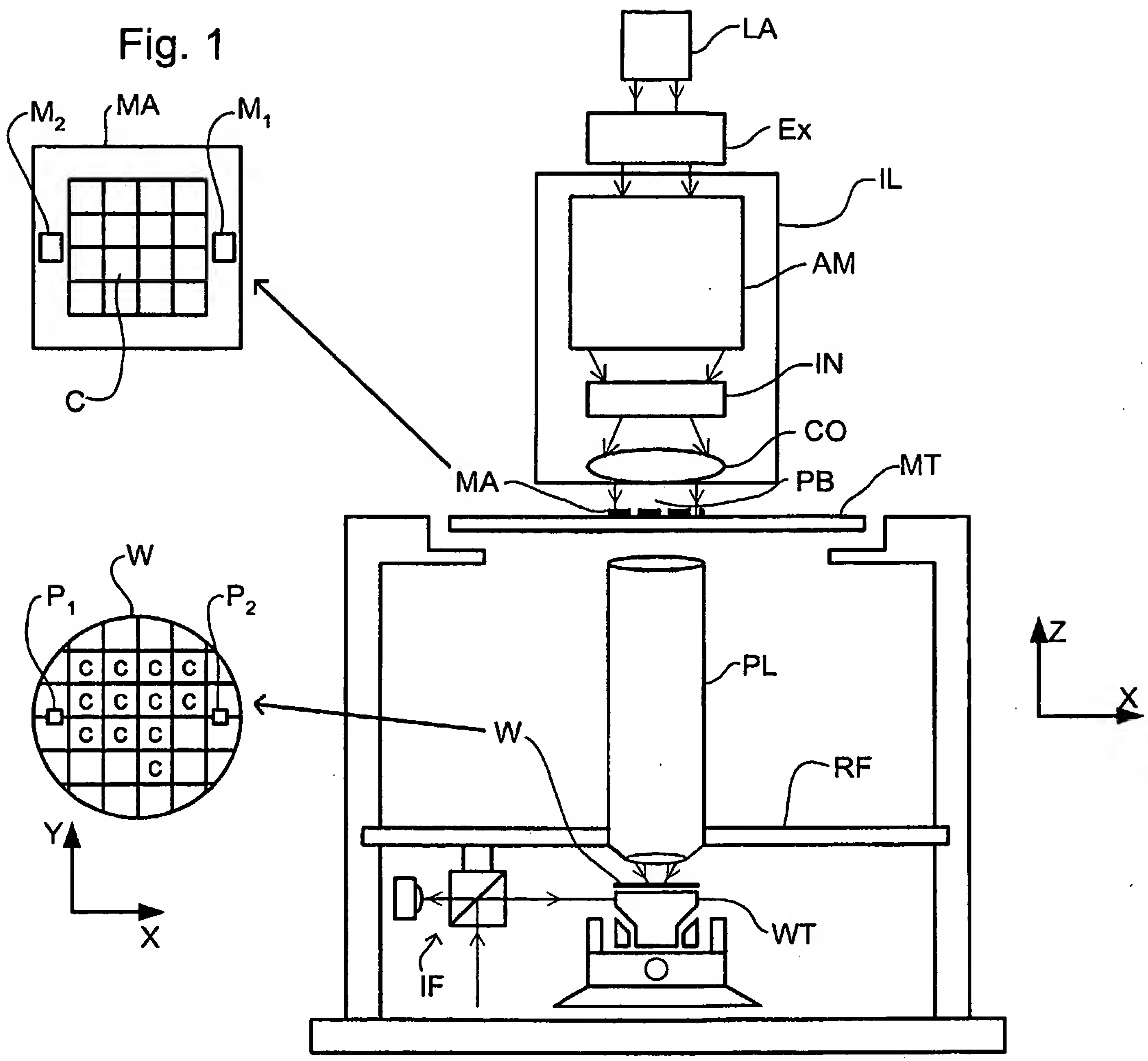


Fig. 2

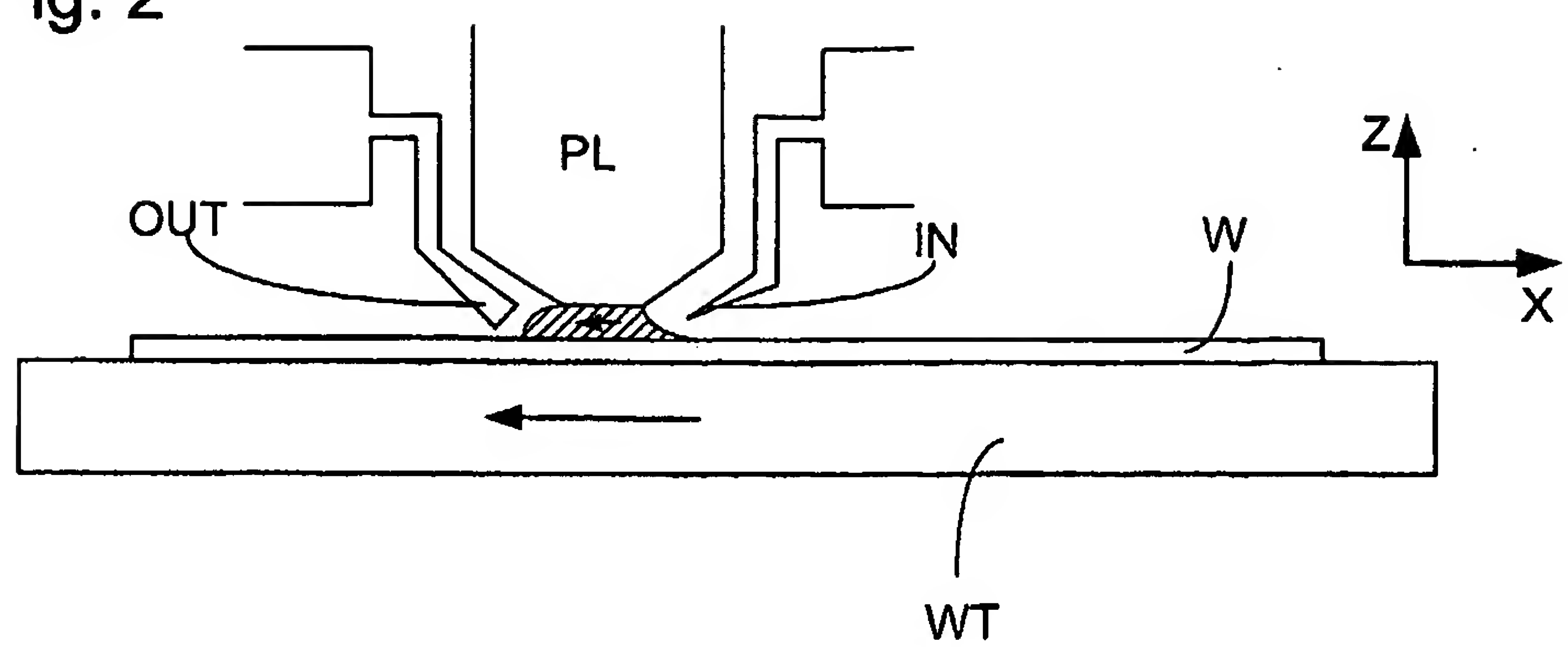


Fig. 3

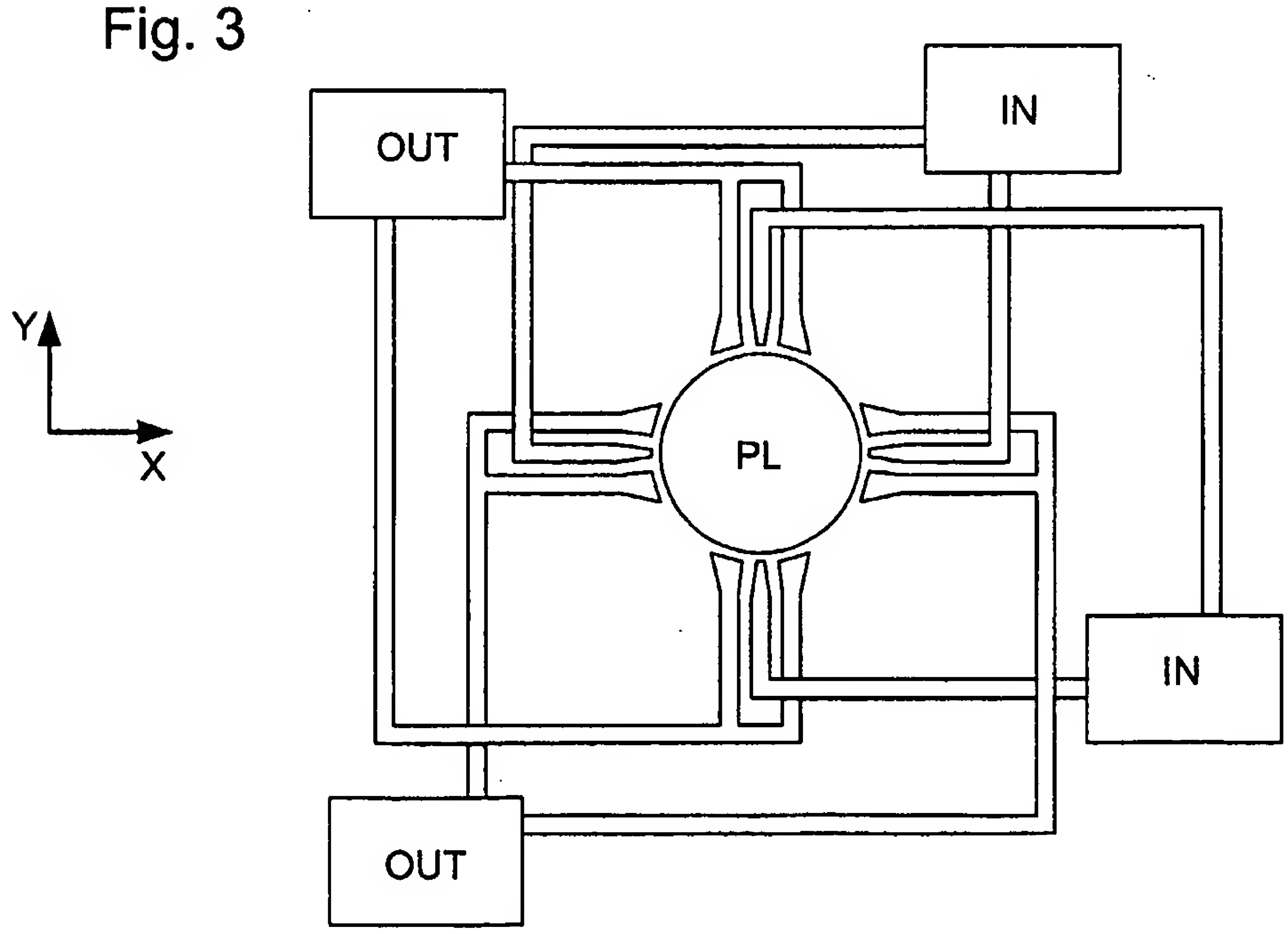


Fig. 4

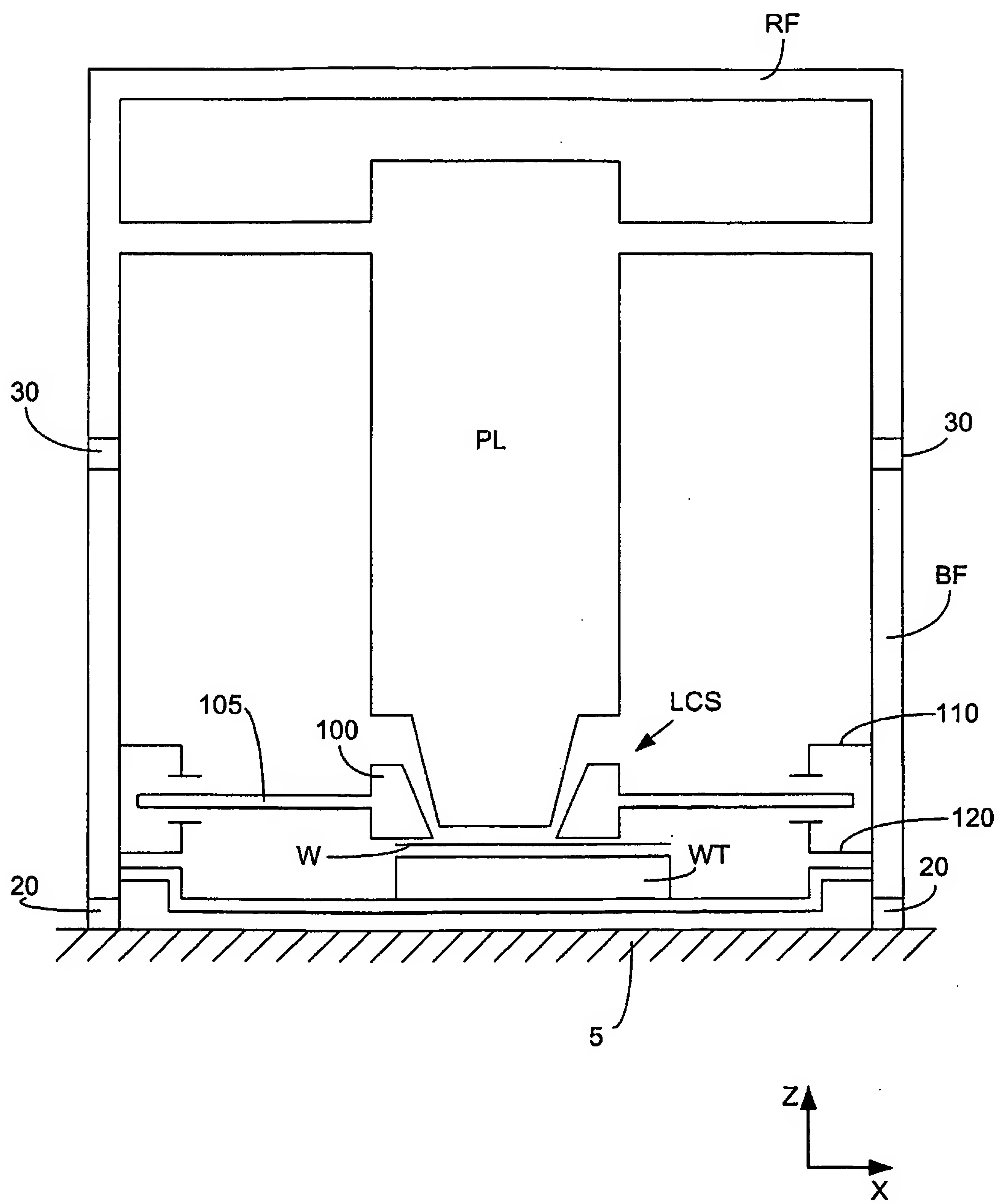
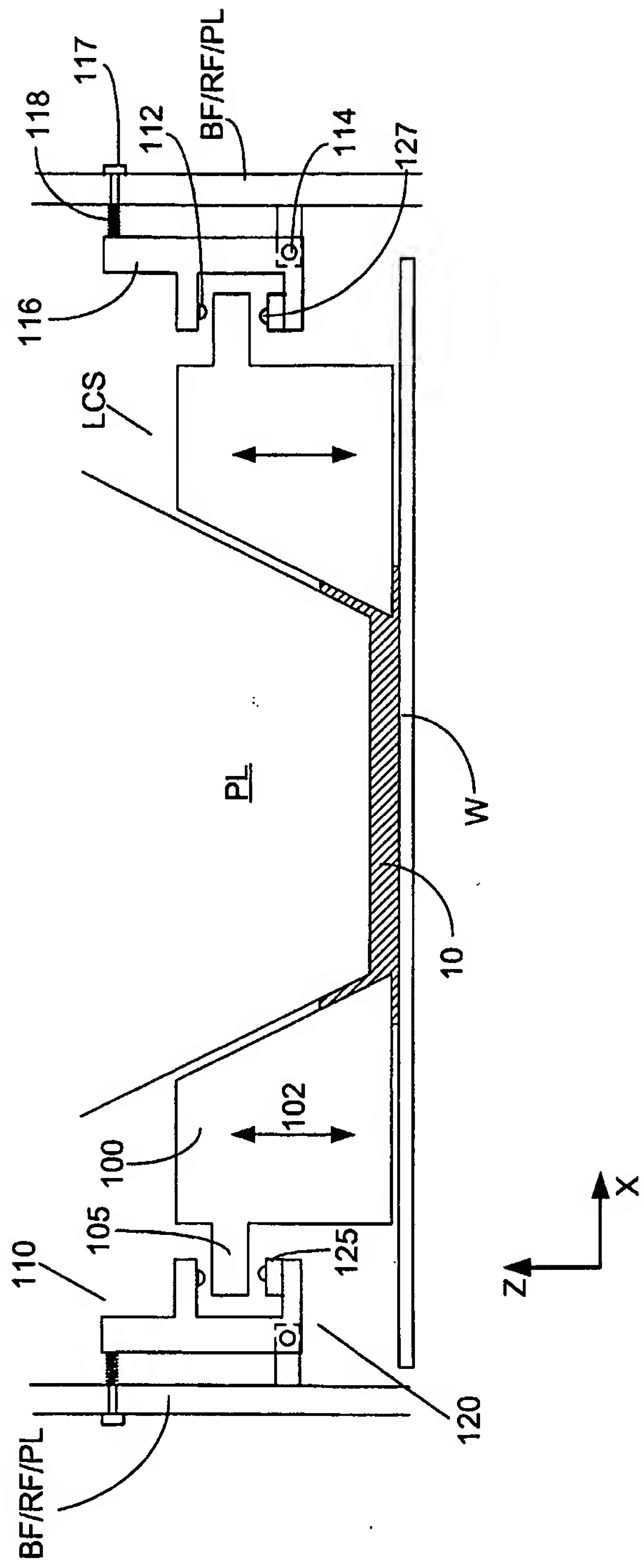


Fig. 5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EUROPEAN SEARCH REPORT

Application Number
EP 03 25 6095

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	PATENT ABSTRACTS OF JAPAN vol. 1999, no. 02, 26 February 1999 (1999-02-26) -& JP 10 303114 A (NIKON CORP), 13 November 1998 (1998-11-13) * abstract * * figure 1 * * paragraph '0018! * ---	1-9	G03F7/20 H01L21/00
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H01L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	21 April 2004	Menck, A

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CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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